

DNA REPLICATION

Replication is the process of making duplicate copies of DNA and it is based upon the principles of complementarity and base pairing. The term semi-conservative replication is used to indicate replication in which each daughter molecule of DNA gets one of the original DNA strands along with a newly synthesized complementary strand.

The supercoiled DNA must first be unwound and this is done by an enzyme called DNA gyrase. The DNA is still in a double helix and the double helix is unwound by the enzyme DNA helicase. The DNA helicase disrupts the hydrogen bonds holding the complementary strands together. Its action is localized and it does not result in breaking the DNA chain. Single strand binding protein (SSB) keeps the separated strands apart.

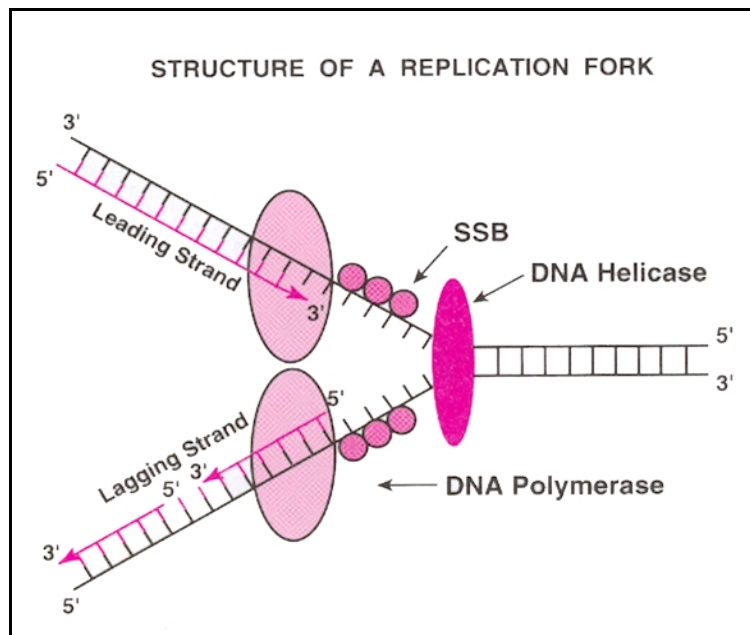
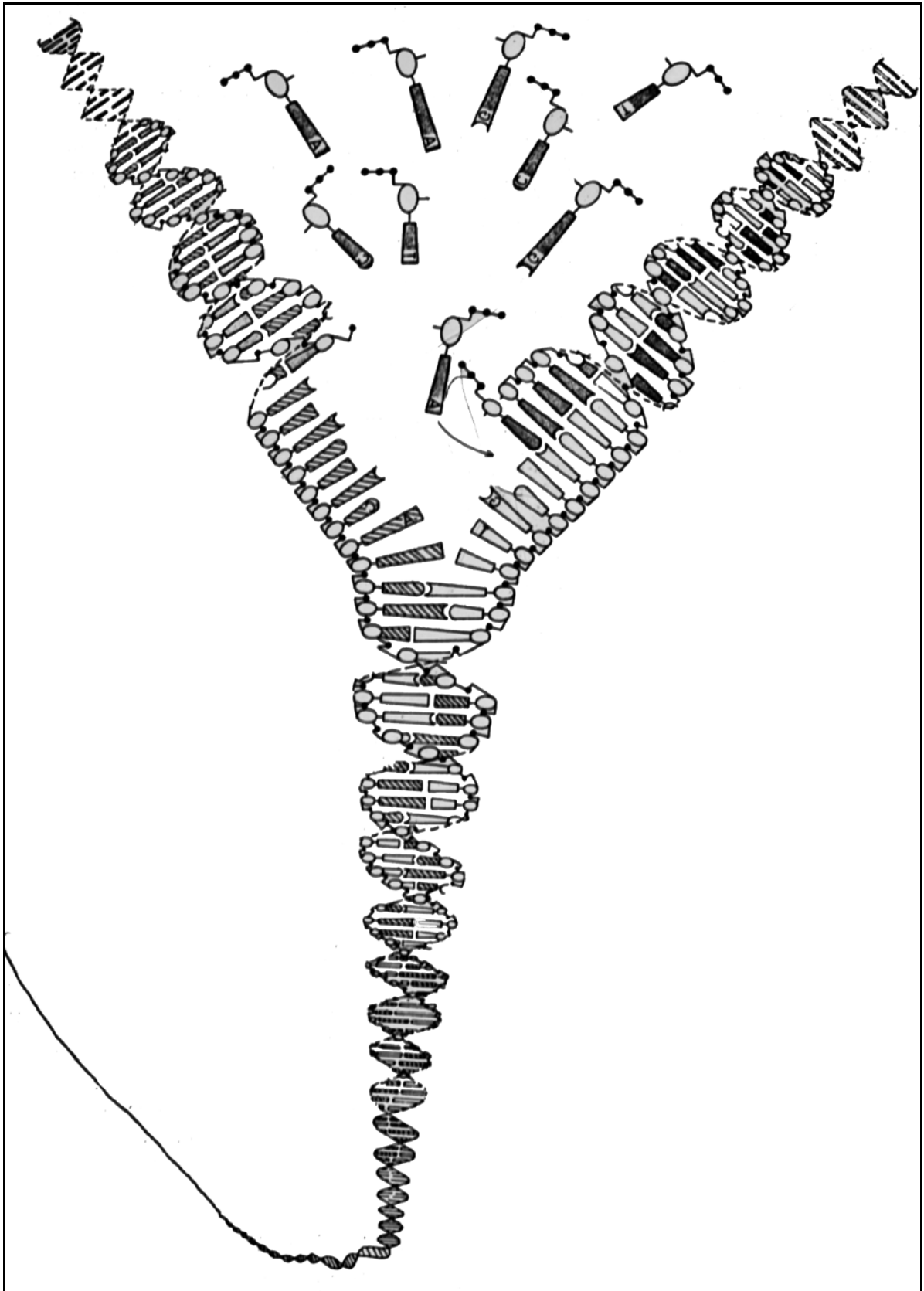


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Each of the separated strands of DNA serves as a template for the synthesis



of a complementary new strand. Individual nucleotides from the nucleotide pool can recognize their partners and align on each template strand by forming hydrogen bonds, but this method alone would be inefficient. The enzyme DNA polymerase III (pol III) efficiently joins correctly matched nucleotide pairs.

Polarity

The newly synthesized nucleic acid strand always occurs in the direction of 5' to 3'. This is based upon the fact that the 5' phosphate group of the new nucleotide joins to the 3' positions of the nucleotide previous nucleotide.

The hydrogen bonding to the template strand and stringing together of the incorporated nucleotides in the newly synthesized strand occurs at a replication fork. The DNA polymerase catalyzes the elongation of the newly formed strand. In fact, a primary function of DNA polymerase is to

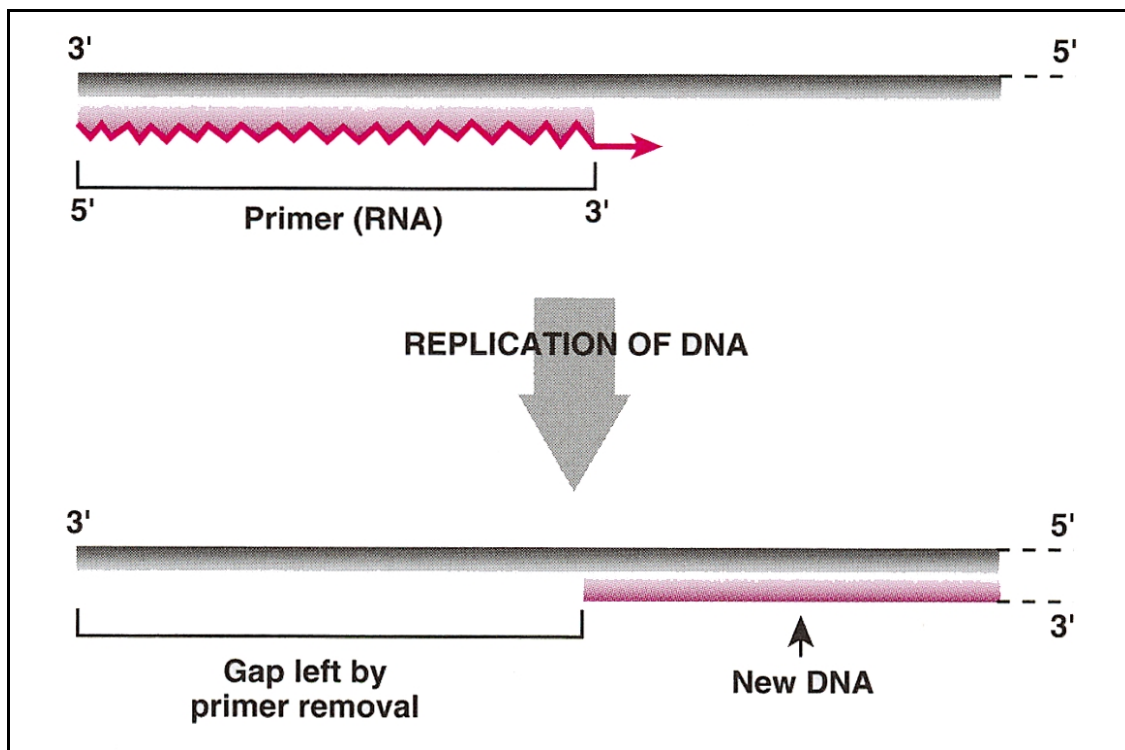
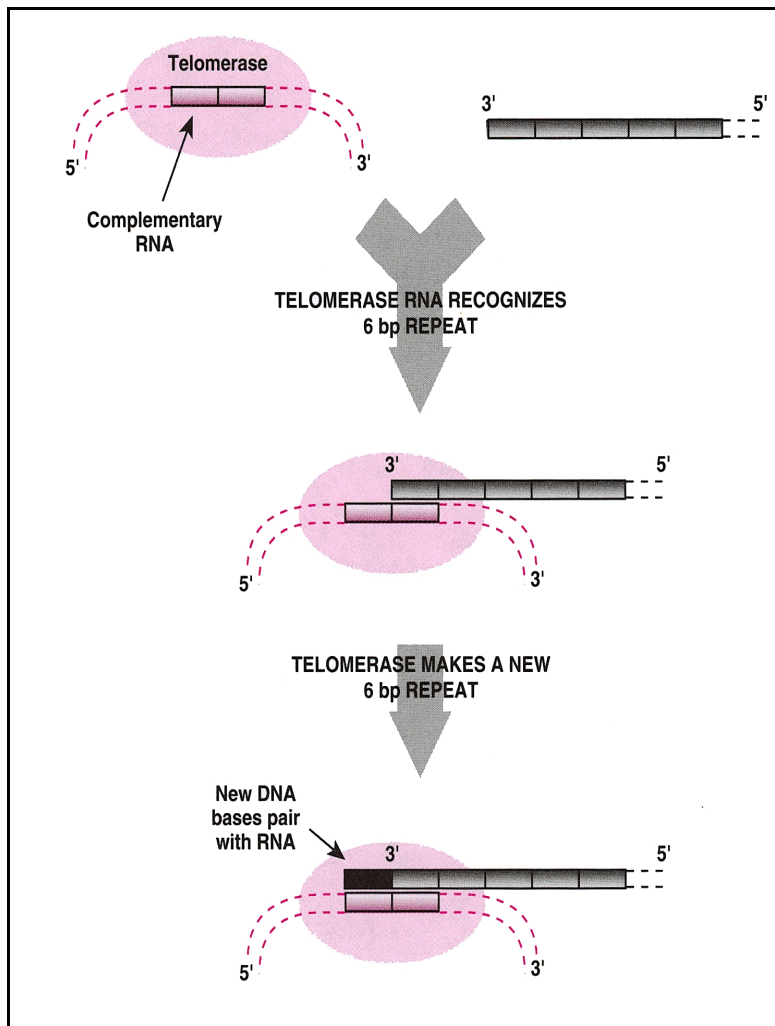
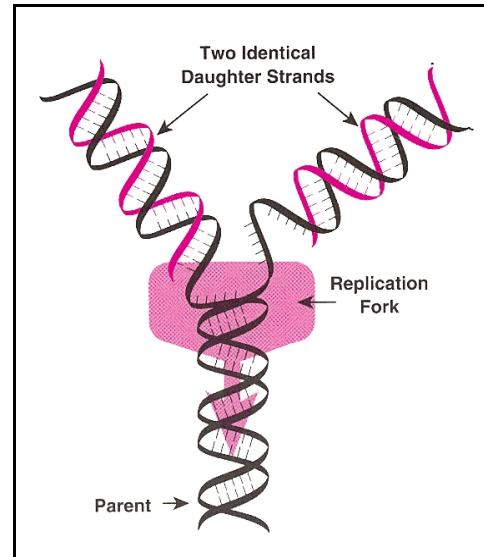


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elongate the new strand. The DNA polymerase by itself cannot actually start the new strand. What is actually needed to start the process is a

primer and this is actually an RNA. A short segment of primer made up of RNA binds to the separated strands of DNA and primes or starts the synthesis of the new DNA strand at the end of the chromosome being duplicated. This RNA primer is later removed leaving a gap where it was originally located. Thus, during each replication cycle the chromosome is shortened due to the loss of the RNA primer. Once past the replication fork, the newly formed DNA strand forms a double helix structure with the template strand.



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This problem is dealt with by an enzyme called **telomerase** that acts at the telomeric end of the chromosome. Telomeres consist of six base pairs repeated about 2,000 times. Telomerase contains a small amount of RNA complementary to this six base pair repeat, recognizes the telomere, and synthesizes new nucleotide sequences to fill in

the gap left by the RNA primer that was responsible for initiating the DNA replication.